IAF SPACE POWER SYMPOSIUM (C3)
Space Power Systems for Ambitious Missions (4)

Author: Mr. Anand Nagesh
Grahaa Space, India

Ms. Aakansha Sharma
Panjab University, India
Mr. Malaya Kumar Biswal M
Grahaa Space, India
Mr. Ramesh Kumar
Grahaa Space, India

MICROBIAL FUEL CELLS : A STATE-OF-THE-ART AND REVOLUTIONIZING TECHNOLOGY FOR SUSTAINABLE MANNED SPACE EXPLORATION BEYOND LOW EARTH ORBIT

Abstract

As we get ready to send humans back to the moon via the Artemis program, it is especially important to consider how astronauts will be living, working, and learning in an environment farther away from Earth than we have ever gone before.The use of microbial fuel cells (MFCs) as an alternative energy conversion mechanism for producing bioenergy has attracted immense attention. As a bio-electrochemical hybrid system, MFCs are capable of converting organic wastes into bioelectricity using effective microorganisms through electrochemical reactions. This leads to significant energy savings and, a decrease in sludge production and energy conversion.

We aim to push the boundaries of space exploration while promoting responsible stewardship of celestial resources, the goal of this paper is to establish a legacy of sustainability and innovation in commercialization and integration into already-existing wastewater treatment facilities on Earth. This paper discusses a standard MFC system with emphasis on its working principle, and physicochemical parameters vital for an MFC to perform in a closed-loop environment in space habitats. Also highlighting the potential benefits of current as well as recent developments in MFC designs and their promising prospects for sustainable and profitable energy recovery. Despite some challenges in translating MFC into real-world applications, the sensitivity and specificity of microbes suggest that they hold great promise for generating bioelectricity from natural wastes and wastewater in controlled environments such as habitats in space. The future of MFC depends on its cost-effectiveness and its ability to continuously generate bioelectricity, which is critical for a permanent presence in a cleaner and more environmentally friendly ecosystem in a closed-loop, energy-efficient, and sustainable manner.